Lecture (3.2)

Think of voicewaves as a function f, and when we sample it we get a vector of recorded values $\vec{f_n}$. (Chapter 1)

$$F\cdot g = c_1 g_1\cdot g + c_2 \cancel{g_2\cdot g}^{0} + \dots c_n \cancel{g_n\cdot g}^{0}$$

$$\int F\cdot g\,dt = c_1 \int g_1\cdot g_1\,dt$$

$$c_1 = \frac{\langle F, g\rangle}{\langle g_1, g_1\rangle} \qquad c_K = \frac{\langle F, g_K\rangle}{\langle g_K, g_K\rangle} = \text{Similarity coefficients}$$

In chapter 3.1 & 3.2, we transform this raw signal by using an orthogonal expansion

$$f(t) = c_1 g_1(t) + c_2 g_2(t) \dots \dots c_n g_n(t)$$

where $\{g_k(t)\}_{k=1}^{n}$ is an orthogonal set $(\langle g_k(t), g_i(t)\rangle = 0)$

and $\langle g_k(t), g_k(t)\rangle \neq 0$

and $\vec{c} = [c_1, c_2, \dots c_n]^T$ is called the transform of f relative to $\{g_k\}$

Also, $c_k = \dfrac{\langle f, g_k\rangle}{\langle g_k, g_k\rangle}$ = Similarity coefficient

Ex $f(t) = \begin{cases} 2, & 0 \le t < \frac{1}{2} \\ 3, & \frac{1}{2} < t < 1 \end{cases}, \quad g(t) = 2t-1, \; 0 \le t < 1 \}$

Find similarity coefficient

$$c = \frac{\langle f, g\rangle}{\langle g, g\rangle} = \frac{1/4}{1/3} = \frac{3}{4}$$

$$\langle f, g\rangle = \int_0^1 f(t)g(t)\,dt$$

$$\langle f, g\rangle = \int_0^{0.5} 2(2t-1)\,dt + \int_{0.5}^{1.0} 3(2t-1)\,dt$$

$$2\left[t^2 - t\right]_0^{0.5} + 3\left[t^2 - t\right]_{0.5}^{1.0}$$

$$2\left[\tfrac{1}{4} - \tfrac{1}{2}\right] + 3\left[(1-1) + (\tfrac{1}{4} - \tfrac{1}{2})\right]$$

$$1/4$$

$$\langle g, g\rangle = \int_0^1 (2t-1)^2\,dt = \frac{1}{2}\int_{-1}^{1} u^2\,du$$

when $t=0$, $u=1$

$u = (2t-1)$

$$= \frac{1}{6}\left[(2t-1)^3\right]_{-1}^{1}$$

$$= \frac{1}{3}$$